

T04D10 – SL Bonding Exam MS

8. D
 9. B
 10. B
 11. D
 12. A
 13. C
 14. B
 15. A
 16. B
 17. D
 18. C
 19. A
 20. B
 21. D
 22. B
 23. B
 24. B
 25. (i)

3

Allotrope	Structure
Diamond	3D array/network involving tetrahedral carbons/each carbon atom joined to four others;
Graphite	layer structure involving trigonal (triangular) planar carbons/with each carbon atom joined to three others/with hexagonal (six-membered) rings of carbon atoms;
C₆₀ fullerene	truncated icosahedrons; <i>Accept carbon atoms form a 'ball' with 32 faces, of which 12 are pentagons and 20 are hexagons, exactly like a soccer ball. Do not accept soccer ball alone.</i>

- (ii) Diamond: covalent bonds (only);
 Graphite: covalent bonds and the separated layers held together by (weak) London/van der Waals'/dispersion forces;

2

[5]

26. (i) as molecules become larger/heavier/have higher M_r values/
 number of electrons increases; van der Waals'/London/
 dispersion forces increase;
 (ii) hydrogen bonding **between molecules** in H₂O; this bonding is stronger
 (than van der Waals' forces);
Must be an implied comparison with (i)

2

2

[4]

27.



Allow a combination of dots, crosses or lines.

bent/V shaped/angular

104.5°

Accept answers in range 104° to 106°

repulsion of the two non-bonding pairs of electrons forces bond angle to be smaller/non-bonding pairs repel more than bonding pairs;

4

[4]

28. $\text{NH}_4^+ > \text{NH}_3 > \text{NH}_2^-$;

NH_4^+ has four bonded electron pairs (and no lone electron pairs);

NH_3 has three bonded electron pairs and one electron lone pair;

NH_2^- has two bonded electron pairs and two electron lone pairs;

Accept correct Lewis structures with lone electron pairs clearly shown.

lone pair-lone pair > lone pair-bonded pair > bonded pair-bonded pair/

lone pairs of electrons repel more than bonding pairs of electrons/OWTTE;

5

Do not accept repulsion between atoms.

[5]

- P 29. (i) Find number of electron pairs/charge centres in (valence shell of) central atom;
electron pairs/charge centres (in valence shell) of central atom repel each other;

Any one of the following:

to positions of minimum energy/repulsion/maximum stability;

pairs forming a double or triple bond act as a single bond;

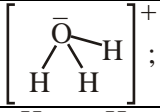
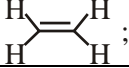
non-bonding pairs repel more than bonding pairs/OWTTE;

3 max

Do not accept repulsion between bonds or atoms.

(ii)

6

Species	Lewis (electron-dot) structure	Shape	Bond angle(s)
H_3O^+		Trigonal/triangular pyramidal;	Allow values in the range 106° to 109.5°;
C_2H_4		Trigonal/triangular planar;	Allow values of approximately 120°;

Accept crosses and dots for electrons in Lewis structures also.

As the Lewis structures were asked for, and not 3D representations, do not penalize incorrectly drawn geometries.

Do not accept structure of hydronium cation without lone pair on oxygen.

No penalty for missing charge.

- (iii) H_3O^+ is polar and explanation either using a diagram or in words, involving the net dipole moment;
e.g. the three individual O-H bond dipole moments add as vectors to give a net dipole moment.

C_2H_4 is non-polar and explanation either using a diagram or in words, involving no net dipole moment;

2

e.g. the vector sum of the individual bond dipole moments is zero.

For simple answers such as bond polarities do not cancel for H_3O^+ and do cancel for C_2H_4 , Award [1], only for the last two marking points.

- (iv) O-H is most polar;
O-H has greatest difference between electronegativities/calculation showing values of 1.4, 0.5 and 0.9 respectively;

2

[13]